Example 3.4

Simple RC Circuit

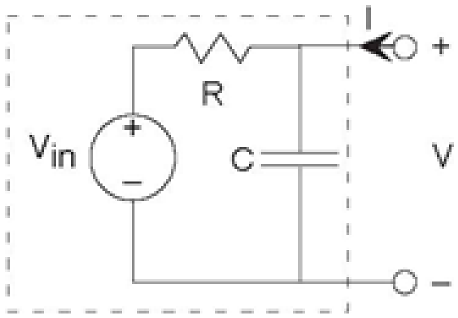

Figure 3.28 Simple RC Circuit

Let's find the Thevenin and Mayer-Norton equivalent circuits for Figure 3.28 (Simple RC Circuit). The open-circuit voltage and short-circuit current techniques still work, except we use impedances and complex amplitudes. The open-circuit voltage corresponds to the transfer function we have already found. When we short the terminals, the capacitor no longer has any effect on the circuit, and the short-circuit current **Isc** equals

$$\frac{V_{out}}{R}$$

. The equivalent impedance can be found by setting the source to zero, and finding the impedance using series and parallel combination rules. In our case, the resistor and capacitor are in parallel once the voltage source is removed (setting it to zero amounts to replacing it with a short-circuit). Thus,

$$Z_{eq} = \left(R \| \frac{1}{j2\pi fC}\right) = \frac{R}{1 + j2\pi fRC}$$

Consequently, we have

$$V_{eq} = \frac{1}{1 + j2\pi fRC} V_{in}$$

$$I_{eq} = \frac{1}{R} V_{in}$$

$$Z_{eq} = \frac{R}{1 + j2\pi fRC}$$

Again, we should check the units of our answer. Note in particular that $j2\pi fRC$ must be dimensionless. Is it?